

What is claimed is:

1 1. A method of creating a binary-coding pattern to
2 be used in binary-coding a multi-value image, said method
3 comprising the steps of:

4 (a) creating a basic pattern shape of the prospective
5 binary-coding pattern by a first arithmetic operation;

6 (b) determining the sequence of lighting pixels
7 composing such basic pattern by a second arithmetic
8 operation; and

9 (c) creating a rectangular pattern, which serves as
10 the prospective binary-coding pattern, based on the
11 resultant basic pattern.

1 2. A method of creating a binary-coding pattern
2 according to claim 1, wherein, in said step (c), said
3 rectangular pattern is created by a third arithmetic
4 operation.

1 3. A method of creating a binary-coding pattern
2 according to claim 1, wherein said step (a) includes the
3 steps of:

4 (a-1) designating a pattern angle through which said
5 binary-coding pattern is turned;

6 (a-2) designating the number of pixels composing said
7 basic pattern; and

8 (a-3) executing an arithmetic operation based on said

9 pattern angle designated in said step (a-1) and said number
10 of pixels designated in said step (a-2).

1 4. A method of creating a binary-coding pattern
2 according to claim 2, wherein said step (a) includes the
3 steps of:

4 (a-1) designating a pattern angle through which said
5 binary-coding pattern is turned;

6 (a-2) designating the number of pixels composing said
7 basic pattern; and

8 (a-3) executing an arithmetic operation based on said
9 pattern angle designated in said step (a-1) and said number
10 of pixels designated in said step (a-2).

1 5. A method of creating a binary-coding pattern
2 according to claim 3, wherein, in said step (a),
3 one or more rectangles are created which have the
4 following corner points: point A(c, 1); point B(a+c, b+1);
5 point C(0, d+1); and point D(a, b+d+1), parameters a, b,
6 c, and d being arbitrary integers satisfying an equation
7 of $n=ad+bc$, where n is the number of pixels, which is
8 designated in said step (a-2), and

9 the one, out of such rectangles, which is at an angle
10 approximate to said pattern angle designated in said step
11 (a-1), is selected as said basic pattern.

1 6. A method of creating a binary-coding pattern

2 according to claim 4, wherein, in said step (a),
3 one or more rectangles are created which have the
4 following corner points: point A(c, 1); point B(a+c, b+1);
5 point C(0, d+1); and point D(a, b+d+1), parameters a, b,
6 c, and d being arbitrary integers satisfying an equation
7 of $n=ad+bc$, where n is the number of pixels, which is
8 designated in said step (a-2), and
9 the one, out of such rectangles, which is at an angle
10 approximate to said pattern angle designated in said step
11 (a-1), is selected as said basic pattern.

1 7. A method of creating a binary-coding pattern
2 according to claim 1, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a distance between a predetermined point in said basic
5 pattern and each of the last-named pixels.

1 8. A method of creating a binary-coding pattern
2 according to claim 6, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a distance between a predetermined point in said basic
5 pattern and each of the last-named pixels.

1 9. A method of creating a binary-coding pattern
2 according to claim 7, wherein, in said step (b), said
3 sequence of lighting the pixels is determined in such a
4 manner that the pixels are lighted sequentially from the

5 one nearer to a predetermined point of said basic pattern,
6 and that the length of an outline of the lighted pixels
7 adjoining to the non-lighted ones is minimal.

1 10. A method of creating a binary-coding pattern
2 according to claim 8, wherein, in said step (b), said
3 sequence of lighting the pixels is determined in such a
4 manner that the pixels are lighted sequentially from the
5 one nearer to a predetermined point of said basic pattern,
6 and that the length of an outline of the lighted pixels
7 adjoining to the non-lighted ones is minimal.

1 11. A method of creating a binary-coding pattern
2 according to claim 7, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a coefficient which relates to a distance between a
5 predetermined point in said basic pattern and each of the
6 last-named pixels.

1 12. A method of creating a binary-coding pattern
2 according to claim 8, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a coefficient which relates to a distance between a
5 predetermined point in said basic pattern and each of the
6 last-named pixels.

1 13. A method of creating a binary-coding pattern

2 according to claim 9, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a coefficient which relates to a distance between a
5 predetermined point in said basic pattern and each of the
6 last-named pixels.

1 14. A method of creating a binary-coding pattern
2 according to claim 10, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a coefficient which relates to a distance between a
5 predetermined point in said basic pattern and each of the
6 last-named pixels.

1 15. A method of creating a binary-coding pattern
2 according to claim 1, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a weight which has been assigned to each of the pixels
5 by an arithmetic operation according to a distance between
6 a predetermined point in said basic pattern and each of
7 the last-named pixels.

1 16. A method of creating a binary-coding pattern
2 according to claim 1, wherein, in said step (c), said
3 rectangular pattern is created by cutting a rectangle in
4 a particular size from a spread of said basic patterns
5 in which said basic patterns are arranged successively
6 in both a primary image scanning direction and a secondary

7 image scanning direction.

1 17. A method of creating a binary-coding pattern
2 according to claim 16, wherein, in said step (c), a
3 motif-pattern showing a distinctive characteristic of said
4 rectangular pattern is cut from said rectangular pattern
5 to represent said rectangular pattern.

1 18. A method of creating a binary-coding pattern
2 according to claim 17, wherein:

3 said motif-pattern occupies a rectangular area that
4 is measured Y in the primary scanning direction by i in
5 the secondary scanning direction, thus being composed of
6 $Y \times i$ pixels;

7 Y measured in the primary scanning direction is equal
8 to a length, measured in the primary scanning direction,
9 of said rectangular pattern of the particular size; and

10 i measured in the secondary scanning direction is
11 equal to a minimum quantity (the number of pixels), measured
12 in the secondary scanning direction, essential for said
13 rectangular area to include a complete set of lightening
14 sequence numbers determined one for each of the pixels
15 composing the basic pattern in said step (b).

1 19. A method of creating a binary-coding pattern
2 according to claim 5, wherein, in said step (c), said
3 rectangular pattern is created by an arithmetic operation

4 such that size (X) of said rectangular pattern measured
5 in a secondary scanning direction satisfies:

6

$$7 \quad \text{size}(X) = \max((n \div \gcd(b, n), (n \div \gcd(d, n)))$$

8

9 and size (Y) of said rectangular pattern measured in a
10 primary scanning direction satisfies:

11

$$12 \quad \text{size}(Y) = \max((n \div \gcd(a, n), (n \div \gcd(c, n)))$$

1 20. A method of creating a binary-coding pattern
2 according to claim 6, wherein, in said step (c), said
3 rectangular pattern is created by an arithmetic operation
4 such that size (X) of said rectangular pattern measured
5 in a secondary scanning direction satisfies:

6

$$7 \quad \text{size}(X) = \max((n \div \gcd(b, n), (n \div \gcd(d, n)))$$

8

9 and size (Y) of said rectangular pattern measured in a
10 primary scanning direction satisfies:

11

$$12 \quad \text{size}(Y) = \max((n \div \gcd(a, n), (n \div \gcd(c, n)))$$

1 21. A method of creating a binary-coding pattern
2 to be used in binary-coding a multi-value image, said method
3 comprising the steps of:

4 (a) creating a basic pattern shape of the prospective

5 binary-coding pattern by a first arithmetic operation;
6 (b) determining the sequence of lighting pixels
7 composing such basic pattern; and
8 (c) creating a rectangular pattern, which serves as
9 the prospective binary-coding pattern, based on the
10 resultant basic pattern.

1 22. A method of creating a binary-coding pattern
2 according to claim 21, wherein, in said step (c), said
3 rectangular pattern is created by a second arithmetic
4 operation.

1 23. A method of creating a binary-coding pattern
2 according to claim 21, wherein said step (a) includes the
3 steps of:

4 (a-1) designating a pattern angle through which said
5 binary-coding pattern is turned;

6 (a-2) designating the number of pixels composing said
7 basic pattern; and

8 (a-3) executing an arithmetic operation based on said
9 pattern angle designated in said step (a-1) and said number
10 of pixels designated in said step (a-2).

1 24. A method of creating a binary-coding pattern
2 according to claim 23, wherein, in said step (a),
3 one or more rectangles are created which have the
4 following corner points: point A(c, 1); point B(a+c, b+1);

5 point C(0, d+1); and point D(a, b+d+1), parameters a, b,
6 c, and d being arbitrary integers satisfying an equation
7 of $n=ad+bc$, where n is the number of pixels, which is
8 designated in said step (a-2), and
9 the one, out of such rectangles, which is at an angle
10 approximate to said pattern angle designated in said step
11 (a-1), is selected as said basic pattern.

1 25. A method of creating a binary-coding pattern
2 according to claim 21, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a distance between a predetermined point in said basic
5 pattern and each of the last-named pixels.

1 26. A method of creating a binary-coding pattern
2 according to claim 25, wherein, in said step (b), said
3 sequence of lighting the pixels is determined in such a
4 manner that the pixels are lighted sequentially from the
5 one nearer to a predetermined point of said basic pattern,
6 and that the length of an outline of the lighted pixels
7 adjoining to the non-lighted ones is minimal.

1 27. A method of creating a binary-coding pattern
2 according to claim 25, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a coefficient which relates to a distance between a
5 predetermined point in said basic pattern and each of the

6 last-named pixels.

1 28. A method of creating a binary-coding pattern
2 according to claim 21, wherein, in said step (c), said
3 rectangular pattern is created by cutting a rectangle in
4 a particular size from a spread of said basic patterns
5 in which said basic patterns are arranged successively
6 in both a primary image scanning direction and a secondary
7 image scanning direction.

1 29. A method of creating a binary-coding pattern
2 to be used in binary-coding a multi-value image, said method
3 comprising the steps of:

4 (a) creating a basic pattern shape of the prospective
5 binary-coding pattern;

6 (b) determining the sequence of lighting pixels
7 composing such basic pattern by a first arithmetic
8 operation; and

9 (c) creating a rectangular pattern, which serves as
10 the prospective binary-coding pattern, based on the
11 resultant basic pattern.

1 30. A method of creating a binary-coding pattern
2 according to claim 29, wherein, in said step (c), said
3 rectangular pattern is created by a second arithmetic
4 operation.

1 31. A method of creating a binary-coding pattern
2 according to claim 29, wherein said step (a) includes the
3 steps of:
4 (a-1) designating a pattern angle through which said
5 binary-coding pattern is turned;
6 (a-2) designating the number of pixels composing said
7 basic pattern; and
8 (a-3) executing an arithmetic operation based on said
9 pattern angle designated in said step (a-1) and said number
10 of pixels designated in said step (a-2).

1 32. A method of creating a binary-coding pattern
2 according to claim 31, wherein, in said step (a),
3 one or more rectangles are created which have the
4 following corner points: point A(c, 1); point B(a+c, b+1);
5 point C(0, d+1); and point D(a, b+d+1), parameters a, b,
6 c, and d being arbitrary integers satisfying an equation
7 of $n=ad+bc$, where n is the number of pixels, which is
8 designated in said step (a-2), and
9 the one, out of such rectangles, which is at an angle
10 approximate to said pattern angle designated in said step
11 (a-1), is selected as said basic pattern.

1 33. A method of creating a binary-coding pattern
2 according to claim 29, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a distance between a predetermined point in said basic

5 pattern and each of the last-named pixels.

1 34. A method of creating a binary-coding pattern
2 according to claim 33, wherein, in said step (b), said
3 sequence of lighting the pixels is determined in such a
4 manner that the pixels are lighted sequentially from the
5 one nearer to a predetermined point of said basic pattern,
6 and that the length of an outline of the lighted pixels
7 adjoining to the non-lighted ones is minimal.

1 35. A method of creating a binary-coding pattern
2 according to claim 33, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a coefficient which relates to a distance between a
5 predetermined point in said basic pattern and each of the
6 last-named pixels.

1 36. A method of creating a binary-coding pattern
2 according to claim 29, wherein, in said step (b), said
3 sequence of lighting the pixels is determined based on
4 a weight which has been assigned to each of the pixels
5 by an arithmetic operation according to a distance between
6 a predetermined point in said basic pattern and each of
7 the last-named pixels.

1 37. A method of creating a binary-coding pattern
2 according to claim 29, wherein, in said step (c), said

3 rectangular pattern is created by cutting a rectangle in
4 a particular size from a spread of said basic patterns
5 in which said basic patterns are arranged successively
6 in both a primary image scanning direction and a secondary
7 image scanning direction.

1 38. A binary-coding pattern which is created based
2 on a basic pattern and is to be used in binary-coding a
3 multi-value image, wherein a series of halftone dots
4 arranged in a network fashion is generated by lighting
5 pixels of said basic pattern sequentially from the one
6 nearer to a predetermined point of the prospective basic
7 pattern in such a manner that the length of an outline
8 of the lighted pixels adjoining to the non-lighted ones
9 is minimal.

1 39. A binary-coding pattern according to claim 38,
2 wherein the sequence of lighting the pixels is determined
3 based on a coefficient which relates to a distance between
4 a predetermined point in said basic pattern and each of
5 the pixels.

1 40. A rectangular binary-coding pattern which is
2 created based on a basic pattern and is to be used in
3 binary-coding a multi-value image, wherein a series of
4 halftone dots arranged in a network fashion is generated
5 by lighting pixels of a motif-pattern, which shows a

6 distinctive characteristic of the binary-coding pattern,
7 in a predetermined sequence, and by arranging said
8 motif-pattern in repetitions in accordance with a
9 predetermined rule.

1 41. A binary-coding pattern according to claim 40,
2 wherein:

3 said motif-pattern occupies a rectangular area that
4 is measured Y in the primary scanning direction by i in
5 the secondary scanning direction, thus being composed of
6 $Y \times i$ pixels;

7 Y measured in the primary scanning direction is equal
8 to a length, measured in the primary scanning direction,
9 of said rectangular pattern of the particular size; and
10 i measured in the secondary scanning direction is
11 equal to a minimum quantity (the number of pixels), measured
12 in the secondary scanning direction, essential for said
13 rectangular area to include a complete set of lightening
14 sequence numbers determined one for each of the pixels
15 composing the basic pattern.

1 42. An apparatus for creating a binary-coding
2 pattern to be used in binary-coding a multi-value image,
3 said apparatus comprising:

4 a basic pattern shape creating section for creating
5 a basic pattern shape of the prospective binary-coding
6 pattern by a first arithmetic operation;

7 a lighting sequence determining section for
8 determining the sequence of lighting pixels composing such
9 basic pattern by a second arithmetic operation; and
10 a rectangular pattern creating section for creating
11 a rectangular pattern, which serves as the prospective
12 binary-coding pattern, by a third arithmetic operation
13 based on the resultant basic pattern.

1 43. An apparatus for creating a binary-coding
2 pattern according to claim 42, wherein said basic pattern
3 shape creating section includes:

4 an angle designating section for designating a
5 pattern angle through which the prospective binary-coding
6 pattern is turned;

7 a number-of-pixels designating section for
8 designating the number of pixels composing said basic
9 pattern; and

10 an arithmetic section for executing an arithmetic
11 operation based on said pattern angle designated by said
12 angle designating section and said number of pixels
13 designated by said number-of-pixels designating section.

1 44. An apparatus for creating a binary-coding
2 pattern according to claim 43, wherein:

3 said basic pattern shape creating section creates
4 one or more rectangles which have the following corner
5 points: point A(c, 1); point B(a+c, b+1); point C(0, d+1);

6 and point $D(a, b+d+1)$, parameters a , b , c , and d being
7 arbitrary integers satisfying an equation of $n=ad+bc$,
8 where n is the number of pixels which is designated by
9 said number-of-pixels designating section, and
10 out of such rectangles, said basic pattern shape
11 creating section selects the one which is at an angle
12 approximate to said pattern angle designated by said
13 number-of-pixels designating section, as said basic
14 pattern.

1 45. An apparatus for creating a binary-coding
2 pattern according to claim 42, wherein said lighting
3 sequence determining section determines said sequence of
4 lighting the pixels based on a distance between a
5 predetermined point in said basic pattern and each of the
6 last-named pixels.

1 46. An apparatus for creating a binary-coding
2 pattern according to claim 45, wherein said lighting
3 sequence determining section determines said sequence of
4 lighting the pixels in such a manner that the pixels are
5 lighted successively from the one nearer to a predetermined
6 point of said basic pattern, and that the length of an
7 outline of the lighted pixels adjoining to the non-lighted
8 ones is minimal.

1 47. An apparatus for creating a binary-coding

2 pattern according to claim 45, wherein said lighting
3 sequence determining section determines said sequence of
4 lighting the pixels based on a coefficient which relates
5 to a distance between a predetermined point in said basic
6 pattern and each of the last-named pixels.

1 48. An apparatus for creating a binary-coding
2 pattern according to claim 42, wherein said rectangular
3 pattern creating section cuts such rectangular pattern
4 in a particular size from a spread of said basic patterns
5 in which said basic patterns are arranged successively
6 in both a primary image scanning direction and a secondary
7 image scanning direction.

1 49. An apparatus for creating a binary-coding
2 pattern according to claim 48, wherein said rectangular
3 pattern creating section cuts a motif-pattern, which shows
4 a distinctive characteristic of the rectangular pattern,
5 from said rectangular pattern as a representative of said
6 rectangular pattern.

1 50. An apparatus for creating a binary-coding
2 pattern according to claim 49, wherein:

3 said motif-pattern occupies a rectangular area that
4 is measured Y in a primary scanning direction by i in a
5 secondary scanning direction, thus being composed of Y
6 $\times i$ pixels;

7 Y measured in the primary scanning direction is equal
8 to a length, measured in the primary scanning direction,
9 of said rectangular pattern of the particular size; and
10 i measured in the secondary scanning direction is
11 equal to a minimum quantity (the number of pixels), measured
12 in the secondary scanning direction, essential for said
13 rectangular area to include a complete set of lightening
14 sequence numbers determined one for each of the pixels
15 composing said basic pattern.

1 51. An apparatus for creating a binary-coding
2 pattern according to claim 44, wherein said rectangular
3 pattern creating section creates said rectangular pattern
4 by an arithmetic operation such that size (X) of said
5 rectangular pattern measured in a secondary scanning
6 direction satisfies:

$$\text{size}(X) = \max((n \div \gcd(b, n)), (n \div \gcd(d, n)))$$

10 and size (Y) of said rectangular pattern measured in a
11 primary scanning direction satisfies:

$$\text{size}(Y) = \max((n \div \gcd(a, n)), (n \div \gcd(c, n)))$$

1 52. A computer-readable recording medium which
2 stores a binary-coding pattern creating program for
3 creating a binary-coding pattern to be used in

4 binary-coding a multi-value image, wherein said program
5 instructs a computer to function as the following:

6 (a) a basic pattern shape creating section for
7 creating a basic pattern shape of the prospective
8 binary-coding pattern by a first arithmetic operation;

9 (b) a lighting sequence determining section for
10 determining the sequence of lighting pixels composing such
11 basic pattern by a second arithmetic operation; and

12 (c) a rectangular pattern creating section for
13 creating a rectangular pattern, which serves as the
14 prospective binary-coding pattern, by a third arithmetic
15 operation based on the resultant basic pattern.

1 53. A computer-readable recording medium according
2 to claim 52, wherein said basic pattern shape creating
3 section includes:

4 an angle designating section for designating a
5 pattern angle through which the prospective binary-coding
6 pattern is turned;

7 a number-of-pixels designating section for
8 designating the number of pixels composing said basic
9 pattern; and

10 an arithmetic section for executing an arithmetic
11 operation based on said pattern angle designated by said
12 angle designating section and said number of pixels
13 designated by said number-of-pixels designating section.

1 54. A computer-readable recording medium according
2 to claim 53, wherein:

3 said basic pattern shape creating section creates
4 one or more rectangles which have the following corner
5 points: point A(c, 1); point B(a+c, b+1); point C(0, d+1);
6 and point D(a, b+d+1), parameters a, b, c, and d being
7 arbitrary integers satisfying an equation of $n=ad+bc$,
8 where n is the number of pixels which is designated by
9 said number-of-pixels designating section, and
10 out of such rectangles, said basic pattern shape
11 creating section selects the one which is at an angle
12 approximate to said pattern angle designated by said
13 number-of-pixels designating section, as said basic
14 pattern.

1 55. A computer-readable recording medium according
2 to claim 52, wherein said lighting sequence determining
3 section determines said sequence of lighting the pixels
4 based on a distance between a predetermined point in said
5 basic pattern and each of the last-named pixels.

1 56. A computer-readable recording medium according
2 to claim 55, wherein said lighting sequence determining
3 section determines said sequence of lighting the pixels
4 in such a manner that the pixels are lighted successively
5 from the one nearer to a predetermined point of said basic
6 pattern, and that the length of an outline of the lighted

7 pixels adjoining to the non-lighted ones is minimal.

1 57. A computer-readable recording medium according
2 to claim 55, wherein said lighting sequence determining
3 section determines said sequence of lighting the pixels
4 based on a coefficient which relates to a distance between
5 a predetermined point in said basic pattern and each of
6 the last-named pixels.

1 58. A computer-readable recording medium according
2 to claim 52, wherein said rectangular pattern creating
3 section cuts such rectangular pattern in a particular size
4 from a spread of said basic patterns in which said basic
5 patterns are arranged successively in both a primary image
6 scanning direction and a secondary image scanning
7 direction.

1 59. A computer-readable recording medium according
2 to claim 58, wherein said rectangular pattern creating
3 section cuts a motif-pattern, which shows a distinctive
4 characteristic of said rectangular pattern, from said
5 rectangular pattern as a representative of said
6 rectangular pattern.

1 60. A computer-readable recording medium according
2 to claim 59, wherein:
3 said motif-pattern occupies a rectangular area that

4 is measured Y in a primary scanning direction by i in a
5 secondary scanning direction, thus being composed of Y
6 $\times i$ pixels;

7 Y measured in the primary scanning direction is equal
8 to a length, measured in the primary scanning direction,
9 of said rectangular pattern of the particular size; and
10 i measured in the secondary scanning direction is
11 equal to a minimum quantity (the number of pixels), measured
12 in the secondary scanning direction, essential for said
13 rectangular area to include a complete set of lightening
14 sequence numbers determined one for each of the pixels
15 composing said basic pattern.

1 61. A computer-readable recording medium according
2 to claim 54, wherein:

3 said rectangular pattern creating section creates
4 said rectangular pattern by an arithmetic operation such
5 that size (X) of said rectangular pattern measured in a
6 secondary scanning direction satisfies:

7

8
$$\text{size}(X) = \max((n \div \gcd(b, n)), (n \div \gcd(d, n)))$$

9

10 and size (Y) of said rectangular pattern measured in a
11 primary scanning direction satisfies:

12

13
$$\text{size}(Y) = \max((n \div \gcd(a, n)), (n \div \gcd(c, n)))$$